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# VII-6. EVALUATION OF CONCOVER® AND BENTOBALLS™ ON CONTAMINATED SEDIMENTS TO REDUCE MORTALITY OF FORAGING WATERFOWL

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## INTRODUCTION

Two products were considered to have potential for use as a physical barrier to feeding waterfowl. One product was Concover®, a blend of recycled paper mulch (99%) and polymers of a cellulosic type as the binding agent (1%). Another product was BentoBalls™ barrier system, a blend of calcium bentonite/organo clays, gravel and polymers that bind together to form a sealant. The first product could be sprayed as a slurry, and the second could be broadcast over contaminated areas to eliminate feeding by waterfowl by acting as a barrier to the sediment. In addition, these products could potentially reduce the movement of WP particles due to water actions.

The objectives of this study were to evaluate the physical characteristics, application rate and longevity of Concover® and BentoBalls™ (clay barrier system) when applied to bottom sediment in a simulated pond setting. The product that held up under mallard use was field tested to determine its effects on waterfowl feeding behavior and mortality at ERF.

We thank Steven Bird, U.S. Army Environmental Center, for providing funding and support for this project, and Bill Gossweiler and staff of the U.S. Army, Fort Richardson, for logistical support. We followed criteria outlined by the Animal Welfare Act and the DWRC Animal Care and Use Committee during this study.

## METHODS

### Laboratory trials

We obtained the Concover® and BentoBalls™ materials from New Waste Concepts, Inc., Perrysburg, Ohio.* The Concover® was not preformulated but, when mixed, it consists of a blend of recycled paper (99%) and cellulosic polymers

* Use of a company name does not imply U.S. Government endorsement of their products.

(1%). The BentoBalls™ are varying sizes of gravel coated with a blend of calcium bentonite/organo clays and polymers that form a clay barrier system.

We placed 18 kg of fine sand in the bottom of a plastic pool 1 m in diameter and 20 cm deep. Twenty liters of the Concover® was mixed at DWRC using the manufacturers' directions, spread evenly over one pool of dry sand about 2–3 cm thick, and allowed to dry for five days before filling with water.

Observations of the Concover® were conducted at least two times daily for three days to observe how well the material held up in water. On the second day, a square (30 × 60 cm) was cut and excess material removed to see if the edges would disintegrate in water. On the fourth day this square of Concover® was placed in a pool in a holding pen where up to 50 mallards had access to the pool.

The BentoBalls™ were applied directly through the water onto the sand of a pool identical to the one used for the Concover®. An initial trial was conducted indoors to determine how BentoBalls™ reacted with water. A single layer (about 9 kg) was applied to about 25 L of water and observed daily for 12 days. A second trial was conducted outside in the holding pen, where up to 50 ducks had access to the pool. The same type of pool with sand was used, and about 13 kg of BentoBalls™ was applied to about 76 L of water, leaving a 15- to 20-cm perimeter of sand around the edge of the pool. The pool was covered for 17 hours to let the clay barrier swell and then uncovered and observed at least two times daily for three days. A third trial, identical to the second, was conducted, except about 27 kg of BentoBalls™ was added to the pool and there was no perimeter. The pool was observed at least two times daily for four days.

### Field trial

The field trial of BentoBalls™ was conducted from 14 to 30 June 1993 at ERF, Alaska. An existing 7- × 20-m pen was chosen for the control and was known to encompass sediment samples showing 0.01- to 0.1-µL levels of white phosphorus (WP) (Clark et al. 1993). A 7- × 7-m area not previously sampled for WP was chosen for the BentoBalls™ pen and enclosed on the sides with polypropylene netting at a height of 2 m above the sediment. Also, plastic panels (3.7 × 0.0025 × 1 m) were placed around the netting to reduce any movement or accumulation of sediment on the BentoBalls™ as it was applied or because of water action. Six randomly selected mallards from a captive population were then placed in each pen for an eight-day pretreatment to gather baseline mortality data. Each bird was marked with a different-colored patagial tag and had primaries 2–9 clipped on the right wing to prevent ducks from flying out of pens. Supplemental food on a floating platform was placed in each pen. Mallards were maintained this way for both the pretreatment and posttreatment.

On 22 June the BentoBalls™ pen was treated with 907 kg of the product, which was equivalent to about 8 cm thick on the bottom sediment. The material was allowed to settle for about 40 hours before introducing six mallards into each control and treated pen for six days. Also, we treated a 1- × 1-m area outside the pens with 45 kg of BentoBalls™ to determine the fate of the product under natural conditions.

Daily bird observations were conducted for both the pretreatment and posttreatment from an observation tower in close proximity to the test pens. At 30-second intervals an observer recorded the number of mallards feeding or loafing in each pen. A mallard was considered feeding when the duck dipped its head below the water surface and loafing when the duck was swimming, preening or floating. Observations were taken for the pretreatment for 30 minutes between 0800 and between 1130 or 1630 and 1730 and for the posttreatment for one hour between 0800 and 1100 and between 1630 and 1900.

At the conclusion of the posttreatment (1 July 1993), the plastic panels were removed from the BentoBalls™ pen, and the birds were observed on 2 July and 4 August 1993. We conducted a follow-up mortality test from 6 to 13 August 1993. As in the pretreatment and posttreatment, six ducks each were placed in the control and treated pen.

In all phases of the field trial, mortality was noted, and dead mallards were collected and stored for white phosphorus analysis.

## RESULTS

### Laboratory trials

Visual inspections indicated that the Concover® was immediately penetrated by the water, and the entire barrier was floating within 30 minutes. Further, the Concover® was readily damaged by mallard activity. In contrast, daily inspections of the BentoBalls™ indicated some of the bentonite/organo clays went into suspension (~10%), especially when the 13-kg treatment was applied. But when the 27-kg treatment was applied, the material appeared to maintain its structure under mallard use for four days. Therefore, the BentoBalls™ barrier system was used in the subsequent field trial.

**Field trial**

During the pretreatment, all of the ducks died in the control and half of the ducks died in the BentoBalls™ pen within the first five days (Fig. VII-6-1). However, no ducks died in the BentoBalls™ pen during the last three days of the pretreatment. But mallards in the BentoBalls™ pen appeared to feed less often than in the control (Fig. VII-6-2).

During the posttreatment, all of the control ducks and none of the BentoBalls™ ducks died, even though it appeared that ducks in both pens were feeding at about the same rates each day (Fig. VII-6-1 and VII-6-2). Observations of the BentoBalls™ 42 days post-application indicated that algae was growing on it.

During the follow-up trial, more control than treated ducks died during the first 55 hours of exposure. However, there were no differences in mortality after 70 hours.

## DISCUSSION

Concover® did not perform as expected in this study. The product didn't remain on the sediment, and it was readily damaged by mallard activity. Product formulation could be re-evaluated. However, a major drawback is the necessity of applying the Concover® to dry sediment. The marsh ponds at ERF would have to be drained and kept dry during the application and for at least a five-day drying period, which could make installation difficult and costs prohibitive.

The BentoBalls™ barrier system performed well under both laboratory and field tests. Lab observations indicated that the BentoBalls™ would swell two to three times their size in water and fill in gaps between individual aggregates of gravel. As it dried, the barrier system would shrink and crack, but it would swell again when rehydrated. During the pretreatment the field results indicated that two times as many ducks died in the control versus the BentoBalls™-treated pen. This could have been because of differences in WP distribution between the pens where ducks feed or because the three surviving mallards could have fed primarily on supplemental food. Thus, both scenarios could result in the reduced likelihood of a duck encountering WP. During the posttreatment, mallards in treated pens appeared to be effectively deterred from picking up WP particles, because there were essentially no differences in feeding activity between control and treated pens. However, it is not clear why ducks in the control pens

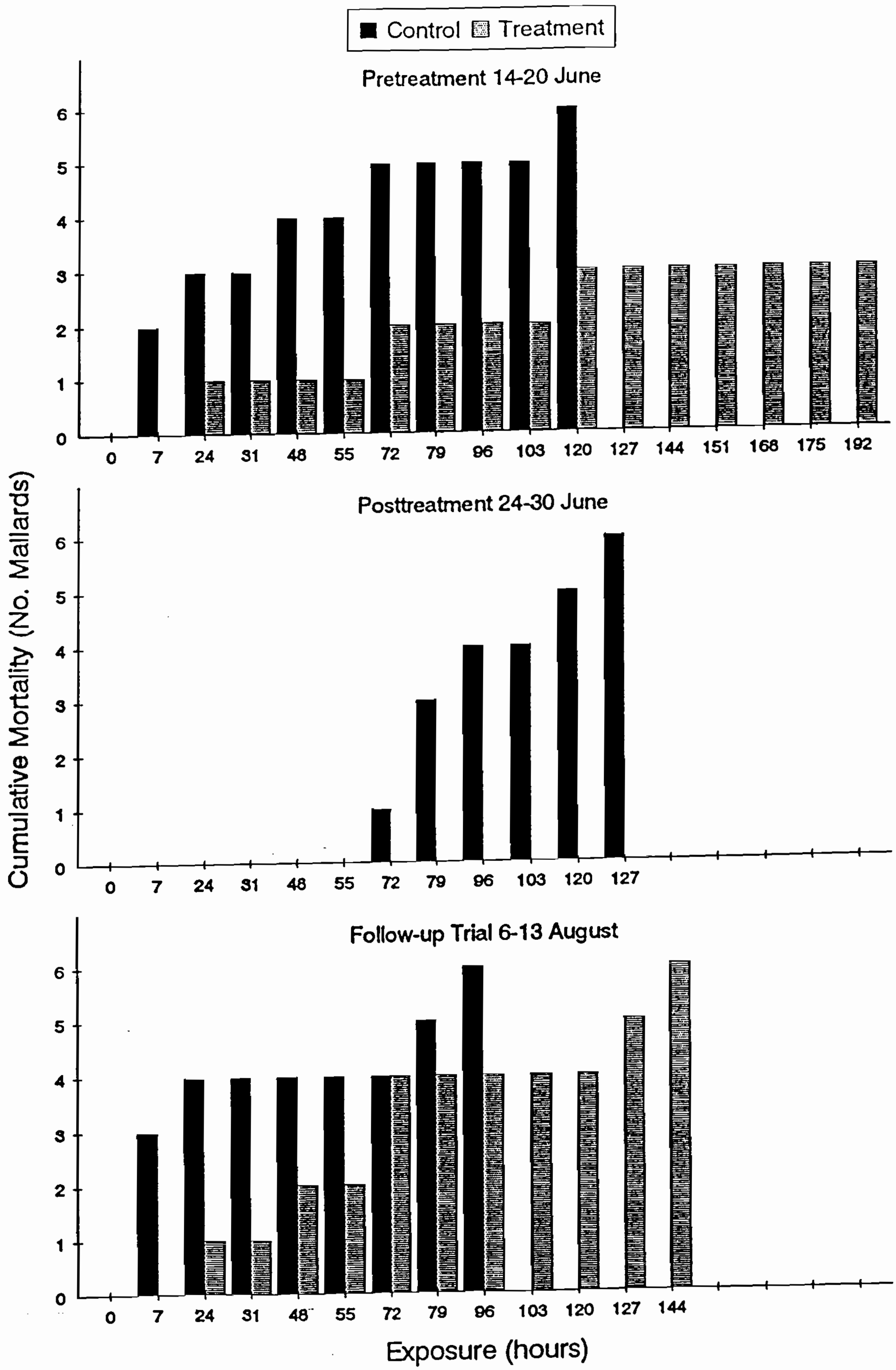


*Figure VII-6-1. Mortality of mallards (six per treatment) under continuous exposure to control or BentoBalls™-treated pens, 14–30 June and 6–13 August 1993, Eagle River Flats.*

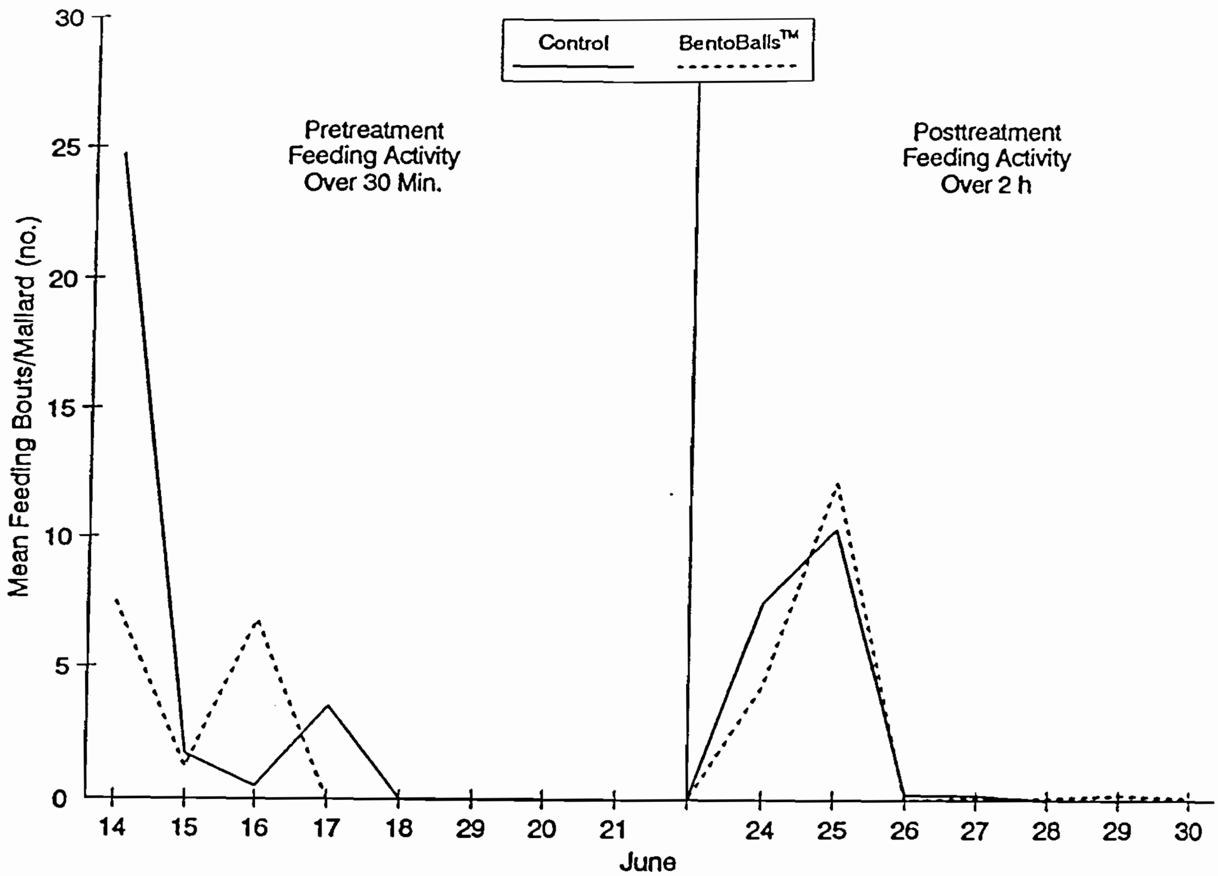


*Figure VII-6-2. Feeding activity of mallards in control and treated pens, 14–30 June 1993, Eagle River Flats.*

did not encounter lethal doses of WP until 72 hours of exposure to the pen. It may be simply be an anomaly due to WP distribution within the pen or individual differences in mallard feeding behavior. During the follow-up trial, mallard mortality may have resulted because only a small portion of the pond was treated. Sediment could have been stirred-up by water action and/or human activity, both during and after the plastic barriers were removed, and may have resulted in deposits of WP particles on top of the barrier system. Alternatively a few holes were made in the barrier by human activity. However, it was noted after the posttreatmen that holes made when retrieving live mallards appeared to refill. Further, the depth of the barrier was initially at least 8 cm, which would have precluded ducks from encountering the sediment below unless removal of the plastic barrier allowed the material to migrate horizontally. Additional studies of the BentoBalls™ barrier system are warranted to determine its effectiveness and longevity for a potential method of remediation at ERF.

## MANAGEMENT IMPLICATIONS

The results of laboratory and field trials of Concover® and BentoBalls™ indicate that the BentoBalls™ barrier system has potential for reducing waterfowl mortality. The cost per hectare of the BentoBalls™ barrier system versus other systems, such as a Plastic Membrane barrier system, would be \$17,537 (\$12,103 materials + \$5,434 on-site manufacturing cost) and \$65,632, respectively (T. Nachtman, pers. comm., 1993). The higher cost of the Plastic Membrane barrier system involves the use of more materials (Fig. VII-6-3). For example, Geotextile would be laid on the existing subgrade, followed by Geonet, Geomembrane and venting pipes to create a gas venting system, and 10 cm of sand for a weighting layer. However, with this system extra substrate at additional cost would be needed for reestablishing vegetation. Further, the performance of the Plastic Membrane barrier system in areas of frequent freezing and thawing is questionable. For example, it is made of four materials that have varying thermal properties, and this may lead to rapid deterioration of individual system components, ultimately causing poorer performance of the entire system in the long run. The constructability of this system is also more difficult in that the flexibility of the Geomembrane decreases in lower temperatures, and cracks may develop in temperatures ranging from 41° to –22°F, especially at seams or spot tack welds.

The advantage of the BentoBalls™ barrier system is its organic clay structure, which allows gas to vent and vegetation to become established. Further, it will shrink and swell as evaporation and flooding occur in the marsh. The costs of production could be minimized by either purchasing a portable batch cement unit or producing the material through a batch cement plant that is idle during the winter months and then utilizing local aggregates. In addition, the bentonite can be shipped by rail to reduce the freight charges. Further research could derive formulas that can be tailored to specific water qualities and types to maximize the clays as a long-term barrier, and development efforts using organic clay can be investigated to augment in-situ fixation of WP and heavy metal contaminants.

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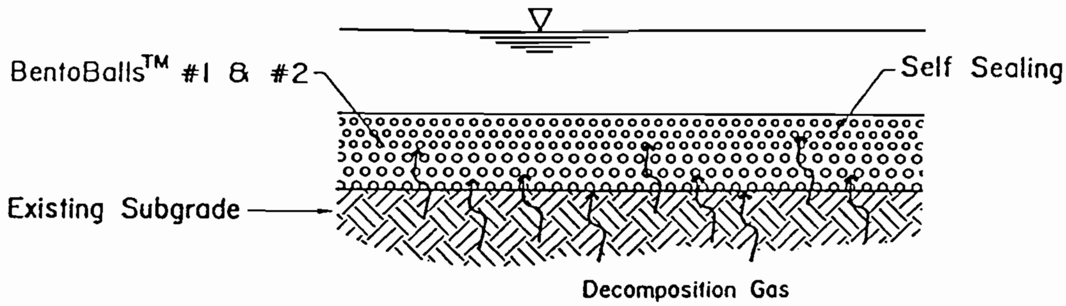
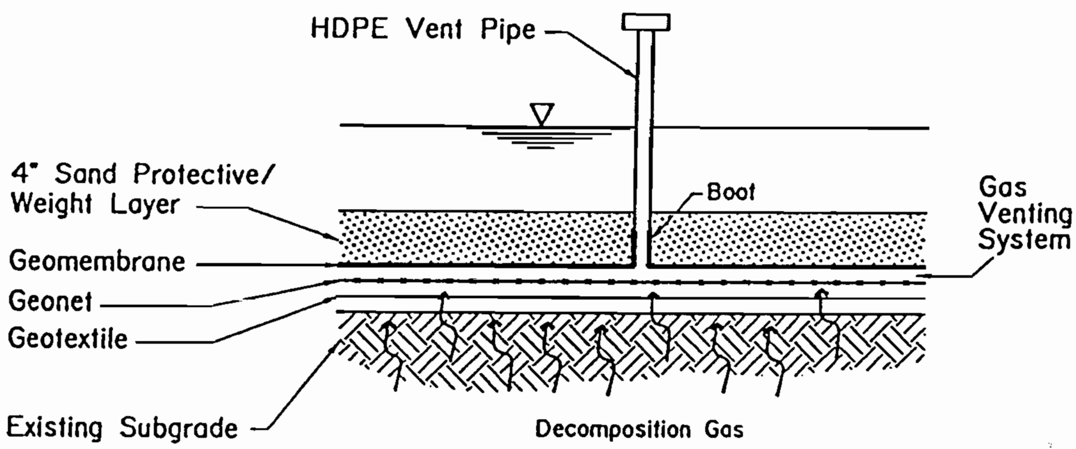



BentoBalls™ Barrier System




Plastic Membrane Barrier System

*Figure VII-6-3. Proposed diagram of the BentoBalls™ barrier system and the Plastic Membrane barrier system as they would be applied at ERF.*

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